



# Health Advisory and Guidelines for Eating Fish from Puddingstone Reservoir (Los Angeles County)

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Fish, Ecotoxicology, and Water Section  
Pesticide and Environmental Toxicology Branch  
Office of Environmental Health Hazard Assessment  
California Environmental Protection Agency

# LIST OF CONTRIBUTORS

## *Office of Environmental Health Hazard Assessment*

### **Authors**

Lori A. Chumney, M.S.

Huyen Tran Pham, M.P.H.

### **Primary Reviewers**

Susan A. Klasing, Ph.D., Section Chief

Shannon R. Murphy, Ph.D.

Wesley Smith, Ph.D.

### **Final Reviewers**

David Ting, Ph.D., Branch Chief

David Siegel, Ph.D., Assistant to the Deputy Director

Allan Hirsch, Chief Deputy Director

### **Director**

Lauren Zeise, Ph.D.

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### **For further information, contact:**

Pesticide and Environmental Toxicology Branch  
Office of Environmental Health Hazard Assessment  
California Environmental Protection Agency

1515 Clay Street, 16<sup>th</sup> Floor

Oakland, California 94612

Telephone: (510) 622-3170

Email address: [fish@oehha.ca.gov](mailto:fish@oehha.ca.gov)

Puddingstone Reservoir Fish Advisory

1001 I Street, P.O. Box 4010

Sacramento, CA 95812-4010

Telephone: (916) 324-7572

## LIST OF ACRONYMS AND ABBREVIATIONS

ATL	Advisory Tissue Level
CDFW	California Department of Fish and Wildlife
DDT(s)	dichlorodiphenyltrichloroethane (DDT) and its metabolites dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE)
DHA	docosahexaenoic acid
EPA	eicosapentaenoic acid
FDA	Food and Drug Administration
Hg	mercury
LACDPR	Los Angeles County Department of Parks and Recreation
LACDPW	Los Angeles County Department of Public Works
LACFCD	Los Angeles County Flood Control District
MDL	method detection limit
MLML	Moss Landing Marine Laboratories
mm	millimeters
OEHHA	Office of Environmental Health Hazard Assessment
PBDEs	polybrominated diphenyl ethers
PCBs	polychlorinated biphenyls
ppb	parts per billion
RL	reporting limit
RWB4	Regional Water Quality Control Board 4 (Los Angeles)
Se	selenium
SGRRMP	San Gabriel River Regional Monitoring Program
SWAMP	Surface Water Ambient Monitoring Program
TMDL	Total Maximum Daily Load
TSMP	Toxic Substances Monitoring Program
USDA	United States Department of Agriculture
USDHHS	United States Department of Health and Human Services
US EPA	United States Environmental Protection Agency

## PREFACE

The Office of Environmental Health Hazard Assessment (OEHHA), a department in the California Environmental Protection Agency, is responsible for evaluating potential public health risks from chemical contamination of sport fish. This includes issuing fish consumption advisories, when appropriate, for the State of California. OEHHA's authorities to conduct these activities are based on mandates in the:

- California Health and Safety Code
  - Section 59009, to protect public health
  - Section 59011, to advise local health authorities
- California Water Code
  - Section 13177.5, to issue health advisories

The health advisories are published in the California Department of Fish and Wildlife Sport Fishing Regulations in the section on public health advisories.

This report presents guidelines for eating fish from Puddingstone Reservoir in Los Angeles County. The report provides background information and a technical description of how the guidelines were developed. The resulting advice is summarized in the illustrations after the Table of Contents and List of Figures and Tables.


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**Women**  
(18-49 Years)

**Children**  
(1-17 Years)



**Women**  
(50+ Years)

**Men**  
(18+ Years)

## A GUIDE TO EATING FISH


*from*

# PUDDINGSTONE RESERVOIR

(LOS ANGELES COUNTY)


**Eat the Good Fish**

Eating fish that are low in chemicals may provide health benefits to children and adults.




**Avoid the Bad Fish**

Eating fish with higher levels of chemicals like mercury or PCBs may cause health problems in children and adults.




**Choose the Right Fish**

Chemicals may be more harmful to unborn babies and children.




**Sunfish Species**



**Black Bass Species**

♥ *high in omega-3s*




**Carp**


**Serving Size**

A serving of fish is about the size and thickness of your hand. Give children smaller servings.

**For Adults**



**For Children**




**California Office of Environmental Health Hazard Assessment**

web [www.oehha.ca.gov/fish](http://www.oehha.ca.gov/fish)


email [fish@oehha.ca.gov](mailto:fish@oehha.ca.gov)

phone (916) 324-7572

**Eat only the skinless fillet**



**Eat only the meat**



Some chemicals are higher in the skin, fat, and guts.

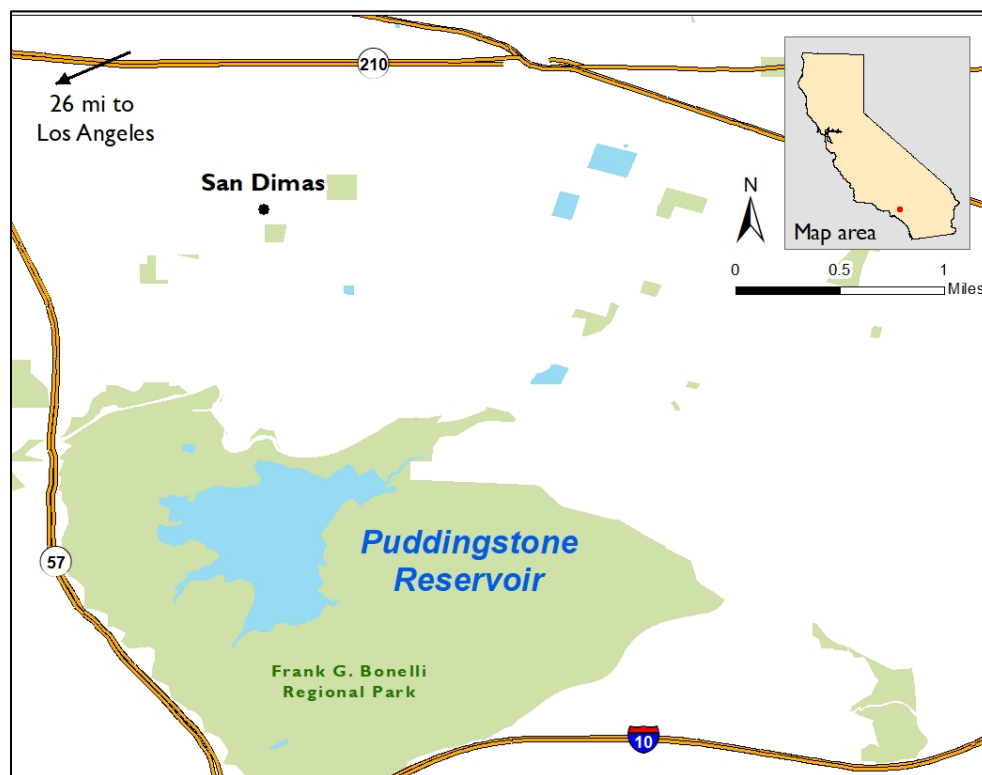
## INTRODUCTION

This report presents guidelines for eating fish from Puddingstone Reservoir (Figure 1) in Los Angeles County, located near the intersection of the Orange (State Route 57) and San Bernardino (Interstate 10) freeways in San Dimas.

### LOCATION

Puddingstone Reservoir was formed in 1928 by construction of a dam created to manage stormwater run-off and control flooding. Shortly thereafter, the 250-acre reservoir was opened to recreational use, offering 5 miles of shoreline. The Los Angeles County Department of Public Works (LACDPW) manages the Puddingstone Dam, and the Los Angeles County Department of Parks and Recreation (LACDPR) manages the Frank G. Bonelli Regional Park, including the reservoir.<sup>1</sup>

FIGURE 1. LOCATION OF PUDDINGSTONE RESERVOIR



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<sup>1</sup> Information regarding Puddingstone Reservoir was obtained from the Bonelli Park Support Foundation and the Los Angeles County Department of Public Works. Online at: <https://www.bonellipark.org/about-the-park.html> and <https://dpw.lacounty.gov/wrd/reservoir/>.



### *APPROACH USED*

The Office of Environmental Health Hazard Assessment (OEHHA) used the results from seven monitoring studies described in this report to develop the Puddingstone Reservoir Advisory. OEHHA uses the following general process in developing consumption advice for sport fish:

- 1) Evaluation of all fish contaminant data available from a water body and selection of appropriate data that meet data quality criteria and sampling plan guidelines.
- 2) Determination of fish species for which adequate data are available to issue fish consumption advice.
- 3) Calculation of an appropriate measure of central tendency (often a weighted arithmetic mean<sup>2</sup>) and other descriptive statistics of the contaminant data, as appropriate, for a chemical of potential concern for the selected fish species.
- 4) Comparison of the chemical concentrations with the OEHHA Advisory Tissue Levels (ATLs) for each chemical of potential concern.
- 5) Development of final advice based on a thorough review of the data and best professional judgment relating to the benefits and risks of consuming a particular fish species.

The ATLs (discussed further in a subsequent section of this report) are chemical levels in fish tissue that are considered acceptable, based on chemical toxicity, for a range of consumption rates. Development of the ATLs also included consideration of health benefits associated with including fish in the diet (OEHHA, 2008). The ATLs should not be interpreted as static “bright lines,” but one component of a complex process of data evaluation and interpretation used by OEHHA in the assessment and communication of the benefits and risks of consuming sport fish.

## CHEMICALS OF POTENTIAL CONCERN

Certain chemicals are considered to be of potential concern for people who eat fish because of their toxicity and their ability to accumulate in fish tissue. The majority of fish consumption advisories in California are issued because of mercury (Hg), followed by polychlorinated biphenyls (PCBs) and, in a few cases, selenium (Se) or some legacy pesticides (pesticides that are no longer used but remain in the environment).

Mercury is a natural element found in some rock and soil. Human activities, such as burning coal and the historic use of mercury to mine gold, also add mercury to the environment. If mercury enters waterways, it can be converted to a more toxic form

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<sup>2</sup> Means are an arithmetic average of individual values and/or a weighted average of composites. A weighted average of composites is calculated by multiplying the chemical concentration in each composite by the number of fish in that composite for each species. Products are then summed and divided by the total number of fish in all composites for that species, combined.

known as methylmercury – which can pass into and build up in fish. High levels of methylmercury can harm the brain, especially in fetuses and children.

PCBs are industrial chemicals previously used in electrical transformers, plastics, and lubricating oils, often as flame retardants or electrical insulators. Their use was banned in the 1970s, but they persist in the environment because they do not break down easily and can accumulate in fish. Depending on the exposure level, PCBs may cause cancer or other health effects, including neurotoxicity, in humans.

Selenium is a naturally occurring metalloid and at low doses is an essential nutrient for many important human health processes, including thyroid regulation and vitamin C metabolism. Higher doses cause selenium toxicity, which can include symptoms ranging from hair loss and gastrointestinal distress to dizziness and tremors.

Chlordanes, dichlorodiphenyltrichloroethane (DDT), dieldrin, and toxaphene are pesticides that were banned from use in 1973 (DDT), the late 1980s (chlordanes and dieldrin) and 1990 (toxaphene), but are still found in some fish in certain California water bodies. Depending on the exposure level, these chemicals may cause cancer or adverse effects on the nervous system.

Polybrominated diphenyl ethers (PBDEs) are a class of flame retardants historically used in a variety of consumer products including furniture, textiles, automotive parts, and electronics. The use of PBDEs in new products was largely phased out by 2013 but, due to their wide usage and persistence in the environment, they are still being detected in fish tissues. PBDEs may affect hormone levels or learning and behavior in children.

Detailed discussion of the toxicity of these chemicals and references are presented in “Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, dieldrin, methylmercury, PCBs, selenium, and toxaphene” (OEHHA, 2008) and “Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Polybrominated Diphenyl Ethers (PBDEs)” (OEHHA, 2011).

All fish species collected from Puddingstone Reservoir and used in advisory development were analyzed for mercury (as a measure of methylmercury), selenium, PCBs, and the legacy pesticides chlordanes (cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, and oxychlordane), dieldrin, DDTs (DDT and its metabolites dichlorodiphenyldichloroethane [DDD] and dichlorodiphenyldichloroethylene [DDE]), and toxaphene. Additionally, Largemouth Bass were analyzed for PBDEs. Fish species that do not normally accumulate PCBs or other organic chemicals may not be analyzed for those contaminants in a particular monitoring study.

## DATA SOURCES

The guidelines for eating fish from Puddingstone Reservoir are based on the chemicals detected in the fish collected for the seven monitoring studies described below. These studies met OEHHA's data quality criteria, including adequate documentation of sample collection, fish preparation methods (e.g., skinning or filleting), chemical analyses, quality assurance, and sufficiently low detection limits. "Sample," as used in this report, refers to an individual fish or a composite of multiple fish for which contaminant data were reported. "Sampling" or "sampled" refers to the act of collecting fish for chemical analysis.

*LOS ANGELES COUNTY FLOOD CONTROL DISTRICT, PECK ROAD PARK LAKE & PUDDINGSTONE RESERVOIR CHARACTERIZATION STUDY (LACFCD)*

The Los Angeles County Flood Control District<sup>3</sup> (LACFCD) collected samples in 2013 in response to the establishment of total maximum daily load (TMDL) limits by the US Environmental Protection Agency (US EPA) for several lakes in Los Angeles County, including Puddingstone Reservoir. The purpose of the study was to characterize the extent and degree of fish and sediment contamination within the designated water bodies to help guide implementation plans and management decisions (LACFCD, 2015). Common Carp and Largemouth Bass were collected from Puddingstone Reservoir for the study and were analyzed for chlordanes, DDTs, dieldrin, and PCBs. Largemouth Bass were further analyzed for mercury.

*LOS ANGELES REGIONAL WATER QUALITY CONTROL BOARD (REGION 4), LOS ANGELES FISH CONTAMINATION STUDY SAN GABRIEL ESTUARY, PUDDINGSTONE, LEGG, 2004-2005 (RWB4-1)*

The Los Angeles Regional Water Quality Control Board, Region 4<sup>4</sup> (RWB4) coordinates ongoing sampling efforts to monitor contaminant levels, including mercury, in sport fish caught from lakes and reservoirs within the region. RWB4 collected Common Carp and Largemouth Bass from Puddingstone Reservoir in 2004, which were analyzed for chlordanes, DDTs, dieldrin, mercury, PCBs, and toxaphene.

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<sup>3</sup> The Peck Road Park Lake & Puddingstone Reservoir Characterization Study (2015) was prepared for the Los Angeles County Flood Control District. Further information on LACFCD can be found online at: <https://dpw.lacounty.gov/LACFCD/web/>

<sup>4</sup> Information on the Los Angeles Regional Water Quality Control Board can be found online at: [http://www.swrcb.ca.gov/water\\_issues/programs/swamp/docs/factsheets/rb4\\_cw101.pdf](http://www.swrcb.ca.gov/water_issues/programs/swamp/docs/factsheets/rb4_cw101.pdf)

*LOS ANGELES REGIONAL WATER QUALITY CONTROL BOARD (REGION 4), LOS ANGELES FISH CONTAMINATION STUDY, 2013 (RWB4-2)*

RWB4 collected Common Carp, Largemouth Bass, and Redear Sunfish from Puddingstone Reservoir in 2013, which were analyzed for mercury.

*SAN GABRIEL RIVER REGIONAL MONITORING PROGRAM (SGRRMP)*

The San Gabriel River Regional Monitoring Program (SGRRMP) was initiated in 2004 to determine the health of the San Gabriel River watershed. The goals of the SGRRMP are to increase awareness of watershed-level issues, better coordinate and integrate monitoring efforts for regulatory compliance, and improve knowledge of existing watershed conditions (SGRRMP, 2015). As part of the monitoring effort, the program collected Bluegill, Common Carp, Largemouth Bass, and Redear Sunfish from Puddingstone Reservoir between 2006 and 2015, which were analyzed for chlordanes, DDTs, dieldrin, mercury, PCBs, selenium, and toxaphene.

*SURFACE WATER AMBIENT MONITORING PROGRAM: CONTAMINANTS IN FISH FROM CALIFORNIA LAKES AND RESERVOIRS, 2007-2008 (SWAMP)*

The SWAMP, operated by the State Water Resources Control Board (SWRCB) in cooperation with RWB4 staff, monitors water quality in California's surface waters. The program collected Largemouth Bass from Puddingstone Reservoir in 2007, to analyze chlordanes, DDTs, dieldrin, mercury, PBDEs, PCBs, and selenium as part of a SWAMP statewide sampling effort to survey contaminants in sport fish found in California lakes and reservoirs (SWRCB, 2010).

*TOXIC SUBSTANCES MONITORING PROGRAM (TSMP)*

The TSMP (1976-2003) was a state water quality-monitoring program managed by the SWRCB (SWRCB, 2007 and 2013). Its objective was to provide statewide information on the occurrence of toxic substances by monitoring water bodies with known or suspected water quality impairment. California Department of Fish and Wildlife (CDFW) staff, then known as the California Department of Fish and Game, collected Largemouth Bass from Puddingstone Reservoir from 1986 to 1999 as part of the program, which were analyzed for mercury and selenium.

*LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS, UPPER SAN GABRIEL RIVER COORDINATED INTEGRATED MONITORING PROGRAM (LACDPW)*

The Upper San Gabriel River Coordinated Integrated Monitoring Program (USGR CIMP) was developed to assess impacts of discharges on receiving waters, determine compliance with TMDLs, characterize pollutant loads, identify pollution sources, and

measure effectiveness of pollutant controls.<sup>5</sup> To that end, in 2017, LACDPW collected Common Carp, which were analyzed for chlordanes, DDTs, dieldrin, and PCBs, and Largemouth Bass, which were analyzed for mercury.

## FISH SAMPLED FROM PUDDINGSTONE RESERVOIR

The fish sampling data used in this advisory were retrieved from the SGRRMP data portal, staff at LACDPR, and the California Environmental Data Exchange Network (CEDEN), the state's repository for environmental data. Samples were excluded when the fish were not legal size to take or did not meet OEHHA's criteria for minimum "edible" size based on species size at maturity, and professional judgment (as described in OEHHA, 2005). A summary of all fish species evaluated for this advisory is shown in Table 1, including the name of the species, number of samples collected, total number of fish, project name, year sampled, and contaminants analyzed.

TABLE 1. FISH SAMPLES EVALUATED FOR THE PUDDINGSTONE RESERVOIR ADVISORY

Common Name	Scientific Name	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed
Bluegill	<i>Lepomis macrochirus</i>	1	3	SGRRMP	2015	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se, Toxaphene
		1	5	SGRRMP	2009	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se, Toxaphene
Common Carp	<i>Cyprinus carpio</i>	9	9	LACDPW <sup>a,b</sup>	2017	Chlordanes, DDTs, Dieldrin, PCBs
		5	25	LACFCD	2013	Chlordanes, DDTs, Dieldrin, PCBs
		4	12	RWB4-1	2004	Chlordanes, DDTs, Dieldrin, PCBs, Toxaphene
		12	12	RWB4-1	2004	Hg
		1	5	RWB4-2	2013	Hg
		1	5	SGRRMP	2015	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se, Toxaphene
		1	6	SGRRMP	2009	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se, Toxaphene

<sup>5</sup> Information on the Upper San Gabriel River Coordinated Integrated Monitoring Program was obtained from the Los Angeles County Department of Public Works. Available online: <http://dpw.lacounty.gov/wmd/irwmp/Prop1SWRP.aspx>.

Common Name	Scientific Name	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed
Largemouth Bass	<i>Micropterus salmoides</i>	9	9	LACDPW <sup>a,b</sup>	2017	Hg
		5	25	LACFCD	2013	Chlordanes, DDTs, Dieldrin, PCBs
		9	9	LACFCD	2013	Hg
		4	20	RWB4-1	2004	Chlordanes, DDTs, Dieldrin, PCBs, Toxaphene
		12	12	RWB4-1	2004	Hg
		12	12	RWB4-2	2013	Hg
		2	10	SGRRMP	2015	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se, Toxaphene
		1	5	SGRRMP	2009	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se, Toxaphene
		1	3	SGRRMP <sup>c</sup>	2008	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se, Toxaphene
		1	16	SGRRMP <sup>c</sup>	2007	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se
		1	5	SWAMP	2007	Chlordanes, Se
		2	10	SWAMP	2007	DDTs, Dieldrin, PBDEs, PCBs
		12	12	SWAMP	2007	Hg
		4	24	TSMP <sup>a,d</sup>	1986, 1991, 1992, 1999	Hg, Se
Redear Sunfish	<i>Lepomis microlophus</i>	1	5	RWB4-2	2013	Hg
		1	3	SGRRMP	2015	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se, Toxaphene
		1	6	SGRRMP <sup>c</sup>	2008	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se, Toxaphene

<sup>a</sup>Study report did not specify whether skin was removed from fillets prior to tissue analysis.

<sup>b</sup>Study report did not specify how fish length was measured (total, fork, or standard length).

<sup>c</sup>Study may have misreported total length as standard length.

<sup>d</sup>Organic data (chlordanes, DDTs, dieldrin, PCBs or toxaphene) generated prior to 2000 were excluded from the analysis because more recent data are considered more reliable due to improved analytical methods.

## CHEMICAL CONCENTRATIONS

As shown in Table 1, samples were analyzed for one or more of the following: total mercury, selenium, chlordanes, DDTs, dieldrin, PBDEs, PCBs (46-59 congeners<sup>6</sup>), and toxaphene. Among the chemicals analyzed in fish tissue samples from Puddingstone Reservoir, only mercury and PCB levels were sufficiently high to impact consumption advice.

All fish samples were prepared as skinless fillets, except for the TSMP and LACDPW studies where the fillet preparation method for Common Carp and Largemouth Bass was not recorded. Samples were analyzed as individual fish or composites.

For this advisory, OEHHA used the weighted (by the number of individual fish) arithmetic mean (average) of the chemical concentrations (in wet weight) for each fish species to estimate average human exposure.

### *MERCURY*

Samples were analyzed for total mercury, as either individual fish or composite samples. Samples collected under the SWAMP program and by RWB4 were analyzed using a direct mercury analyzer (DMA), which utilizes thermal decomposition and atomic absorption. Samples collected by the LACFCD, LACDPW, and SGRRMP were analyzed using variations of the cold vapor atomic fluorescence spectrometry technique (EPA methods 1630M, 7471A, and 245.7, respectively). Samples collected for the SGRRMP program were analyzed at the Institute for Integrated Research in Materials, Environments and Society (IIRMES) Laboratories at California State University, Long Beach, and samples collected for the LACDPW study were analyzed at Eurofins Frontier Global Sciences, Inc. All other samples were analyzed at the CDFW Moss Landing Marine Laboratories (MLML).

OEHHA assumed all mercury detected was methylmercury, which is the most common form found in fish and is also the more toxic form (Bloom, 1992). Table 2 shows the averages and ranges for total length<sup>7</sup>, as well as mercury concentrations in each fish species. The DMA method detection limit (MDL)<sup>8</sup> and the reporting limit (RL)<sup>9</sup> for total mercury were reported in units of parts per billion (ppb) for each study as follows: (RWB4-1: MDL= 9, RL= 26; RWB4-2: MDL=4, RL=12; SCRRMP: MDL=10, RL=12; SWAMP: MDL=12, RL=12; LACDPW: MDL=3, RL=10). Although mercury was

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<sup>6</sup> Congeners are related compounds with similar chemical forms. Of the 209 possible PCB congeners, 54-55 are generally reported.

<sup>7</sup> Total length is the maximum length of the fish, measured from the tip of the closed mouth to the tip of the pinched tail fin.

<sup>8</sup> The MDL is the lowest quantity of a chemical that can be distinguished (as greater than zero) in a sample.

<sup>9</sup> The RL is the lowest quantity of a chemical that can be accurately quantified in a sample.

detected at commonly found concentrations in the TSMP and LACFCD studies, the MDL and RL for mercury were not reported or that information was not available.

#### *PCBs, PBDEs, AND PESTICIDES*

Some composite samples were analyzed for PCBs, PBDEs, and the legacy pesticides (chlordanes, DDTs, dieldrin, and toxaphene). Pesticides, PBDEs and PCBs were analyzed by various methods using gas chromatography at the CDFW Water Pollution Control Laboratory, IIRMES Laboratories, and Eurofins Frontier Global Sciences. For chlordanes, DDTs, PCBs, and PBDEs, each of the concentrations presented was the sum of the detected parent compound, congeners, or metabolites, where applicable. Since the MDLs or RLs were relatively low ( $\leq 10$  ppb; except for samples tested for toxaphene which were  $\leq 50$  ppb), individual congeners or metabolites with concentrations reported as non-detects were assumed to be zero. This is a standard method of handling non-detect values for PCBs and other chemicals with multiple congeners or metabolites in a given sample when detection levels are adequate (US EPA, 2000a). Table 2 shows the averages and ranges for total length<sup>10</sup>, as well as PCB concentrations in each fish species. Although these chemicals were detected at commonly found concentrations in the TSMP study, the MDL and RL were not reported.

#### *SELENIUM*

The CDFW MLML and IIRMES Laboratories conducted selenium analysis on species collected by SWAMP and SGRRMP, respectively. Samples were analyzed as composites, using inductively coupled plasma-mass spectrometry (ICP-MS). The ICP-MS method utilizes desolvation, atomization and ionization with ion separation based on a mass-to-charge ratio to detect the total selenium concentration in a sample. The ICP-MS method detection limit (MDL) and the reporting limit (RL) for total selenium were reported at 25 or 100, and 50 or 300 ppb, respectively. Although selenium was detected at commonly found concentrations in the TSMP study, the MDL and RL were not reported.

Concentrations of chlordanes, dieldrin, DDTs, PBDEs, selenium, and toxaphene were lower than the corresponding ATL threshold values for daily consumption (OEHHA, 2008 and 2011). These chemicals were therefore not considered further for developing consumption advice and are not shown in this report.

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<sup>10</sup> Total length is the maximum length of the fish, measured from the tip of the closed mouth to the tip of the pinched tail fin.



TABLE 2. MERCURY AND PCB CONCENTRATIONS IN FISH FROM PUDDINGSTONE RESERVOIR

Species from Puddingstone Reservoir	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Mercury (ppb)	
					Mean*	Range**
Common Carp	15	28	596	395 - 800	41	0 - 92
Largemouth Bass	63	112	384	311 - 598	296	90 - 744
Sunfish Species	5	22	184	115 - 285	20	10 - 31
Bluegill	2	8	171	115 - 238	24	20 - 30
Redear Sunfish	3	14	192	131 - 285	18	10 - 31
					PCBs (ppb)	
Common Carp	20	57	661	395 - 1011	82	3 - 208
Largemouth Bass	16	89	380	305 - 520	19	0 - 45
Sunfish Species	4	17	187	115 - 238	2	0 - 7
Bluegill	2	8	171	115 - 238	5	0 - 7
Redear Sunfish	2	9	202	197 - 212	0	0 - 0

\*Means are an arithmetic average of individual values and/or a weighted average of composites.

\*\*Range of individuals and/or range of the composites.

## DEVELOPMENT OF GUIDELINES FOR EATING FISH FROM PUDDINGSTONE RESERVOIR

The OEHHA fish advisory process considers the health benefits of fish consumption as well as the risk from exposure to the chemical contaminants found in fish. Benefits are included in the advisory process because there is considerable evidence and scientific consensus that fish should be part of a healthy, well-balanced diet. Fish contain many nutrients that are important for general health and, in particular, help promote optimal growth and development of babies and young children, and may reduce the incidence of heart disease in adults (FDA/US EPA, 2017; American Heart Association, 2016; OEHHA, 2008; Institute of Medicine, 2007; Kris-Etherton et al., 2002). Fish are a significant source of the specific omega-3 fatty acids, docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), thought to be associated with these beneficial health effects (USDA/USDHHS, 2015; Weaver et al., 2008).

The 2015-2020 U.S. Dietary Guidelines recommend that 1) the general population “consume eight or more ounces per week (less for young children)” of a variety of seafood<sup>11</sup> “for the total package of nutrients that seafood provides, including its EPA and DHA content” and 2) “women who are pregnant or breastfeeding should consume at least eight and up to twelve ounces of a variety of seafood per week from choices that are lower in methylmercury” (USDA/USDHHS, 2015). The particular fish that

<sup>11</sup> “Marine animals that live in the sea and in freshwater lakes and rivers. Seafood includes fish, such as salmon, tuna, trout, and tilapia, and shellfish, such as shrimp, crab, and oysters” (USDHHS/USDA, 2015).

people eat is an important factor in determining the net beneficial effects of fish consumption. For example, studies have shown that children of mothers who ate low-mercury fish during pregnancy scored better on cognitive tests compared to children of mothers who did not eat fish or ate high-mercury fish (Oken et al., 2005 and 2008). Accordingly, because of the high mercury content of certain fish species, the US Food and Drug Administration (FDA) and US EPA recommend that women who are pregnant (or might become pregnant) or breastfeeding, and young children avoid consuming shark, swordfish, tilefish (Gulf of Mexico), bigeye tuna, marlin, orange roughy, and king mackerel (FDA/US EPA, 2017).

In order to address the potential health concerns associated with exposure to contaminants in sport fish, OEHHA has established ATLS for chemicals that are known to accumulate in the edible tissues of fish. ATLS consider both the toxicity of the chemical and potential benefits of eating fish. OEHHA uses the ATLS to determine the maximum number of servings per week that consumers can eat, for each species and at each location, to limit their exposure to these contaminants. Consumers can use OEHHA's guidance when choosing which fish and how much to eat as part of an overall healthy diet.

There are two sets of ATLS for methylmercury in fish because of the age-related toxicity of this chemical (OEHHA, 2008). The fetus and children are more sensitive to the toxic effects of methylmercury. Thus, the ATLS for the sensitive population, including women who might become pregnant (typically 18 to 49 years of age) and children 1-17 years, are lower than those for women 50 years and older, and men 18 years and older. The lower ATL values for the sensitive population provide additional protection to allow for normal growth and development of the brain and nervous system of unborn babies and children. Detailed discussion about the toxicity of common fish contaminants and health benefits of fish consumption, as well as derivation of the ATLS, are provided in "Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, dieldrin, methylmercury, PCBs, selenium, and toxaphene" (OEHHA, 2008) and "Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Polybrominated Diphenyl Ethers (PBDEs)" (OEHHA, 2011). A list of the ATLS used in this report is presented in Appendix I.

For each fish species in this advisory, OEHHA compared the mean mercury and PCB concentrations detected in the fillet to the corresponding ATLS to establish the maximum number of servings per week that could be consumed (see Appendix I). A serving size is considered to be 8 ounces, prior to cooking, or about the size and thickness of a hand for fish fillets. Children should be given smaller servings. For smaller fish species, several individuals may be required to yield a serving.

The consumption advice for a fish species is initially based on the chemical with the lowest allowable number of servings per week. Because some chemicals, such as mercury and PCBs, are known to have similar adverse effects, additivity of toxicity is assumed in such cases and may be assessed using multiple chemical exposure

methodology (US EPA, 1989 and 2000b). If two or more chemicals with similar adverse effects are present in fish tissue at levels above the corresponding ATL values for daily consumption, multiple chemical exposure methodology is employed. This may result in advising the sensitive population to consume fewer meals per week than would be the case for the presence of one chemical alone, in a similar concentration. The potential effect of multiple chemical exposures (mercury and PCBs) was assessed in Common Carp and Largemouth Bass, and did not affect advice for either species. Advice for all species in this advisory was based solely on mercury or PCB concentrations.

OEHHA recommends that individuals strive to meet the US Dietary Guidelines seafood consumption recommendations, while also adhering to federal and OEHHA recommendations to limit the consumption of fish with higher contaminant levels. The advice discussed in the following section represents the maximum recommended number of servings per week for different fish species. People should eat no more than the recommended number of servings for each fish species or species group. OEHHA's consumption advice for a particular fish species can be extended to other closely related fish species<sup>12</sup> known to accumulate similar levels of contaminants.

Consumption advice should not be combined. That is, if a person chooses to eat a fish from the "one-serving-a-week" category, then they should not eat any other fish from any source (including commercial) until the next week. If a person chooses to eat a fish from the "two-servings-per-week" category, they can combine fish species from that category, or eat one fish from that category and one from a category that recommends more than two-servings-per-week (if available), for a total of two servings in that week. Then they should not eat any other fish from any source (including commercial) until the following week.

## CONSUMPTION ADVICE FOR FISH FROM PUDDINGSTONE RESERVOIR

OEHHA's advisory protocol requires at least nine fish of a species to be collected from a water body before an advisory can be developed for the primary contaminant of concern. This is to ensure the sample dataset is representative of the fish species population in the water body. In some cases, an exception is made for species that are commonly caught and consumed from a given water body but where available data may be limited. For Puddingstone Reservoir, the sample size criterion was met for the following species: Common Carp, Largemouth Bass, and sunfish species. There were not sufficient data to evaluate other species that may be found in this water body. For fish species found in Puddingstone Reservoir that are not included in this advisory, OEHHA recommends following the [statewide advisory for lakes and reservoirs without site-specific advice](#).

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<sup>12</sup> Fish species within the same genus are most closely related, and family is the next level of relationship.

*BLACK BASS SPECIES (LARGEMOUTH BASS)*

The mean mercury and PCB concentrations in Largemouth Bass from Puddingstone Reservoir were 296 and 19 ppb, respectively. Based on the concentration of mercury, OEHHA recommends a maximum of one serving a week of black bass species from Puddingstone Reservoir for the sensitive population (women 18 to 49 years and children 1 to 17 years), and a maximum of two servings a week for the general population (women 50 years and older, and men 18 years and older).

OEHHA has evaluated mercury concentrations in black bass species in many water bodies in California and has found a similar range of mercury concentrations when two or more of these species were caught from the same water body. Therefore, OEHHA extends the consumption advice for Largemouth Bass to other black bass species, including Redeye, Smallmouth, and Spotted Bass.

*COMMON CARP*

The mean mercury and PCB concentrations in Common Carp from Puddingstone Reservoir were 41 and 82 ppb, respectively. OEHHA recommends a maximum of one serving a week of Channel Catfish for both the sensitive population (women 18 to 49 years and children 1 to 17 years) and the general population (women 50 years and older, and men 18 years and older), based on PCBs.

*SUNFISH SPECIES (BLUEGILL, REDEAR SUNFISH)*

The mean mercury and PCB concentrations in sunfish species from Puddingstone Reservoir were 20 ppb and 2 ppb, respectively. Mercury and PCB concentrations for individual sunfish species were as follows, Bluegill (Hg: 24 ppb, PCB: 5 ppb), and Redear Sunfish (Hg: 18, PCB: 0 ppb). Based on the concentration of mercury and PCBs in these sunfish species, OEHHA recommends a maximum of seven servings a week of sunfish species for both the sensitive population (women 18 to 49 years and children 1 to 17 years), and the general population (women 50 years and older, and men 18 years and older).

OEHHA has evaluated mercury concentrations in sunfish species in many water bodies in California and has found a similar range of mercury concentrations when two or more of these species were caught from the same water body. Therefore, OEHHA extends the consumption advice for sunfish species (Bluegill, Redear Sunfish) to other sunfish species, including Green Sunfish and Pumpkinseed.

**RECOMMENDED MAXIMUM NUMBER OF SERVINGS**

The recommended maximum numbers of servings per week for fish from Puddingstone Reservoir are shown in Table 3.

TABLE 3. RECOMMENDED MAXIMUM NUMBER OF SERVINGS PER WEEK FOR FISH FROM PUDDINGSTONE RESERVOIR

<b>Fish Species from Puddingstone Reservoir</b>	<b>Women 18–49 years and Children 1-17 years</b>	<b>Women 50 years and older and Men 18 years and older</b>
Black Bass species	1	2
Common Carp	1	1
Sunfish species	7	7

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## APPENDIX I. ADVISORY TISSUE LEVELS

Advisory Tissue Levels (ATLs) guide the development of advice for people eating sport fish. ATLs are levels of contaminants found in fish that correspond to the maximum numbers of recommended fish servings. OEHHA uses ATLs to provide advice to prevent consumers from being exposed to:

- More than the average daily reference dose<sup>13</sup> for chemicals not known to cause cancer, such as methylmercury, or
- For cancer-causing chemicals, a risk level greater than one additional cancer case in a population of 10,000 people consuming fish at the given consumption rate over a lifetime. This cancer endpoint is the maximum acceptable risk level recommended by the US EPA (2000b) for fish advisories.

For each chemical, ATLs were determined for both cancer and non-cancer risk, if appropriate, for one to seven eight-ounce servings per week. The most health-protective ATLs for each chemical, selected from either cancer or non-cancer based risk, are shown in the table below for zero to seven servings per week. When the guidelines for eating fish from Puddingstone Reservoir are followed, exposure to chemicals in fish from Puddingstone Reservoir would be at or below the average daily reference dose or the cancer risk probability of one in 10,000.

ADVISORY TISSUE LEVELS FOR SELECTED ANALYTES

Contaminant	Consumption Frequency Categories (8-ounce servings/week) <sup>a</sup> and ATLs (in ppb)							
	7	6	5	4	3	2	1	0
Chlordanes	≤ 80	>80-90	>90-110	>110-140	>140-190	>190-280	>280-560	>560
DDTs	≤ 220	>220-260	>260-310	>310-390	>390-520	>520-1,000	>1,000-2,100	>2,100
Dieldrin	≤ 7	>7-8	>8-9	>9-11	>11-15	>15-23	>23-46	>46
MeHg (Women 18-49 and children 1-17)	≤ 31	>31-36	>36-44	>44-55	>55-70	>70-150	>150-440	>440
MeHg (Women > 49 and men)	≤ 94	>94-109	>109-130	>130-160	>160-220	>220-440	>440-1,310	>1,310
PBDEs	≤ 45	>45-52	>52-63	>63-78	>78-100	>100-210	>210-630	>630
PCBs	≤ 9	>9-10	>10-13	>13-16	>16-21	>21-42	>42-120	>120
Selenium	≤ 1000	>1,000-1200	>1,200-1,400	>1,400-1,800	>1,800-2,500	>2,500-4,900	>4,900-15,000	>15,000
Toxaphene	≤ 87	>87-100	>100-120	>120-150	>150-200	>200-300	>300-610	>610

<sup>a</sup> Serving sizes (prior to cooking, wet weight) are based on an average 160-pound person. Individuals weighing less than 160 pounds should eat proportionately smaller amounts.

<sup>13</sup> The reference dose is an estimate of the maximum daily exposure to a chemical likely to be without significant risk of harmful health effects during a lifetime.